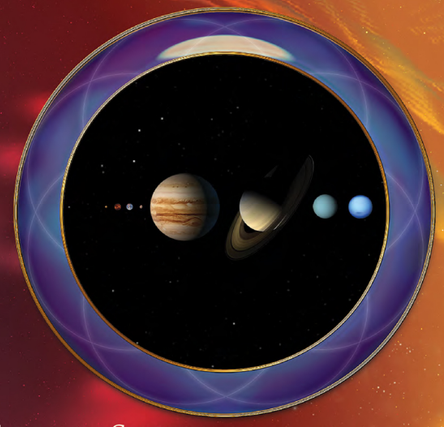
Journey through the cosmos

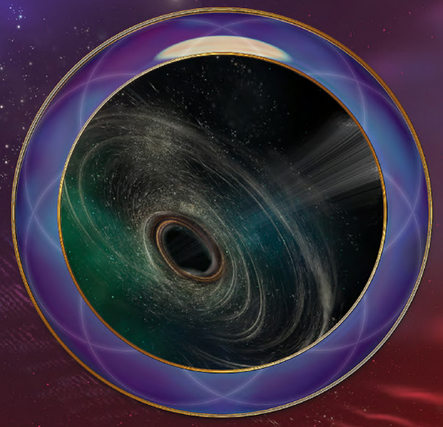
Earth



Solar System

The Galaxy

Nearby Galaxies



The Distant Universe

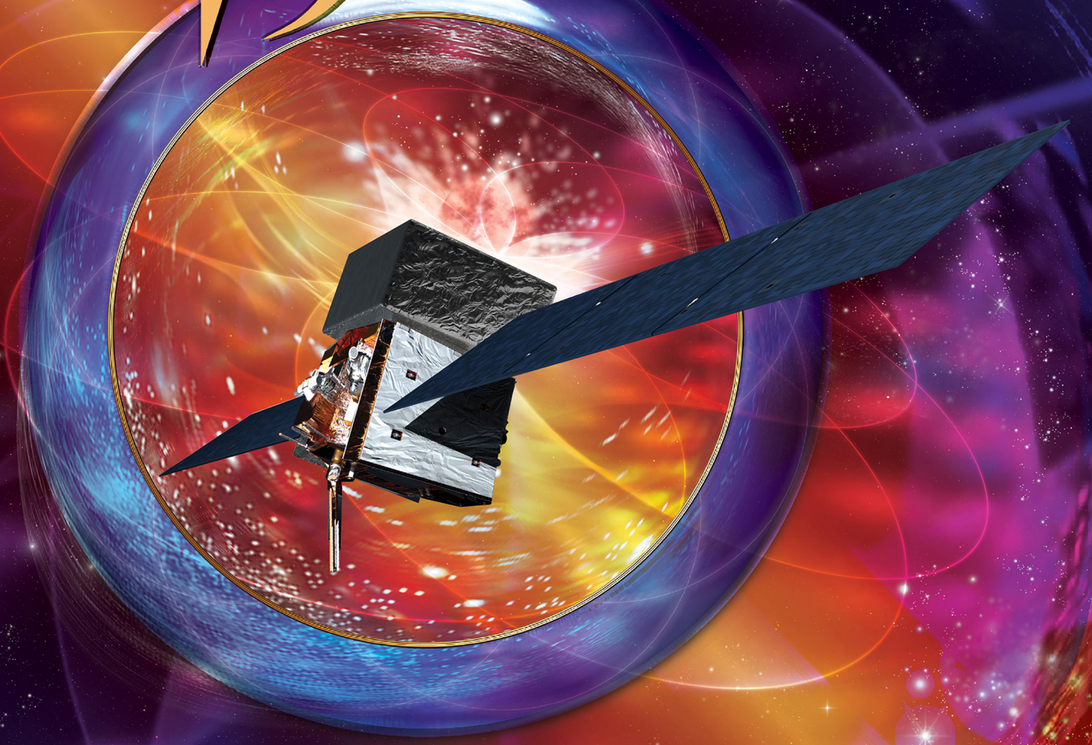
Credit: NASA/Sonoma State University, Aurore Simonnet

www.nasa.gov

National Aeronautics and Space Administration

Our High-Energy Universe

15 Years



with the Fermi Gamma-ray Space Telescope

www.nasa.gov

National Aeronautics and Space Administration

FERMI'S GAMMA-RAY COSMOS

Fermi Six-year Sky Map

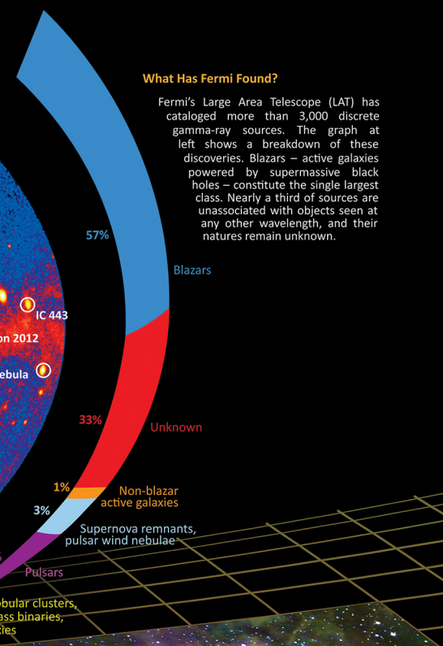
This all-sky view, centered on our Milky Way Galaxy, is the deepest and best-resolved portrait of the gamma-ray sky to date. It incorporates observations by NASA's Fermi Gamma-ray Space Telescope from August 2008 to August 2014 at energies greater than 1 billion electron volts (GeV). For comparison, the energy of visible light falls between 2 and 3 electron volts. Lighter shades indicate stronger emission.
NASA/DOE/Fermi LAT Collaboration

The gamma-ray sky isn't dark even far away from bright sources. Some of this radiation arises close to home, when high-velocity protons (cosmic rays) interact with interstellar gas and starlight. Much of the emission originates far beyond our galaxy and is thought to be the collective glow of sources too faint to detect directly.

GRB 130427A
PSR J1311–3430
Cygnus X
IC 443
Nova Mon 2012
Crab Nebula
NGC 6624
B0218+357
LMC
3C454.3

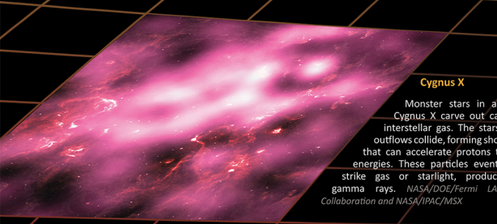
What Has Fermi Found?

Fermi's Large Area Telescope (LAT) has cataloged more than 3,000 discrete gamma-ray sources. The graph at left shows a breakdown of these discoveries. Blazars – active galaxies powered by supermassive black holes – constitute the single largest class. Nearly a third of sources are unassociated with objects seen at any other wavelength, and their natures remain unknown.



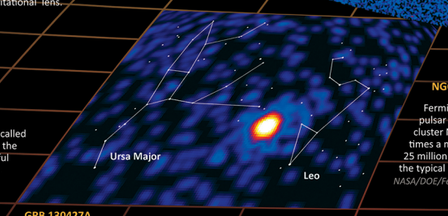
B0218+357

The gravity of a faint foreground galaxy causes light from the distant blazar B0218+357 to take different paths and form dual images (bright spots in this Hubble photo). The paths have different lengths, so when one image has a flare, it will appear in the other after a delay. Fermi detected delays of nearly 12 days in B0218, providing the first gamma-ray measurements of a gravitational lens.
NASA/ESA and the Hubble Legacy Archive



Cygnus X

Monster stars in a region called Cygnus X carve out cavities in the interstellar gas. The stars' powerful outflows collide, forming shock waves that can accelerate protons to high energies. These particles eventually strike gas or starlight, producing gamma rays. *NASA/DOE/Fermi LAT Collaboration and NASA/IPAC/MSX*

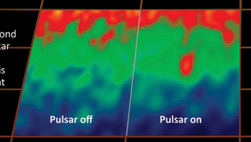


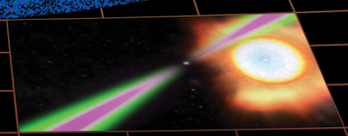
GRB 130427A

On April 27, 2013, a blast of light from a dying star in a distant galaxy became the focus of astronomers around the world. The explosion, known as a gamma-ray burst and designated GRB 130427A, was detected by Fermi for about 20 hours. The burst included a 95 GeV gamma ray, the most energetic light yet detected from a GRB.
NASA/DOE/Fermi LAT Collaboration

NGC 6624

Fermi found the youngest millisecond pulsar yet known, in the globular star cluster NGC 6624. Spinning 11,000 times a minute, pulsar J1823–3021A is 25 million years old, less than 3 percent the typical age.
NASA/DOE/Fermi LAT Collaboration



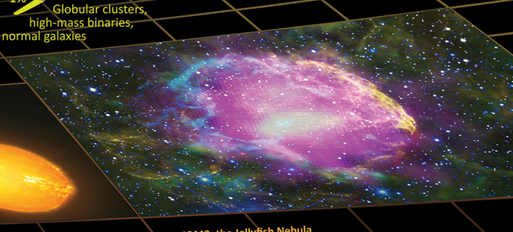


PSR J1311-3430

Gamma-ray pulsar J1311-3430 heats the facing side of its companion star and is slowly evaporating it, as shown in this artist's rendering. The material often blocks the pulsar's radio beam.
NASA's Goddard Space Flight Center/Cruz deWilde

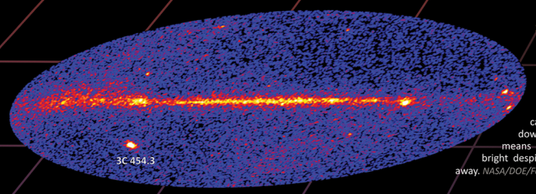
Nova Mon 2012

Fermi observations prove that stellar outbursts called novae emit gamma rays. Novae typically occur when a white dwarf in a binary system with a sun-like star erupts as shown in this artist's rendering of Nova Monocerotis in 2012. Gamma rays likely arise from colliding shock waves in the rapidly expanding debris.
NASA's Goddard Space Flight Center/S. Wiessinger



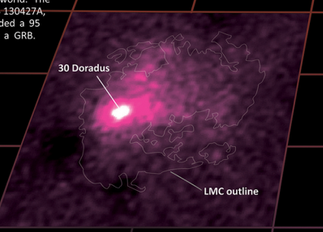
IC443, the Jellyfish Nebula

The shock waves of supernova remnants like the Jellyfish Nebula can accelerate protons to near the speed of light. When they slam into nearby gas clouds, gamma rays are produced. Fermi detects this emission, confirming that supernova remnants accelerate high-energy cosmic rays. *NASA/DOE/Fermi LAT Collaboration; NOAO/AURA/NSF, JPL-Caltech/UCLA*



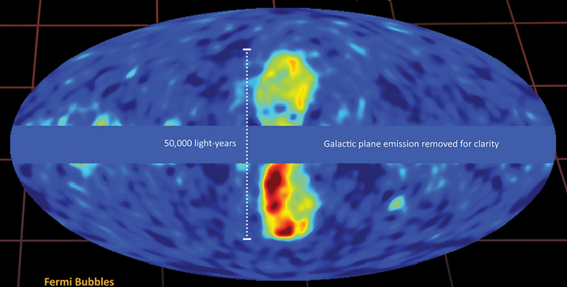
3C 454.3

In December 2009, 3C 454.3 was briefly the brightest object in the gamma-ray sky. The gamma rays come from a jet powered by matter falling toward the galaxy's supermassive black hole. In this case, we're looking almost right down the barrel of the jet, which means the blazar can be especially bright despite lying 7 billion light-years away. *NASA/DOE/Fermi LAT Collaboration*



LMC

Fermi sees gamma rays from star-forming regions like 30 Doradus in the Large Magellanic Cloud (LMC). More stars are forming in this "star factory" than in any similar location in the Milky Way, leading to intense gamma-ray emission.
NASA/DOE/Fermi LAT Collaboration



Fermi Bubbles

Fermi data revealed vast gamma-ray bubbles extending tens of thousands of light-years from the Milky Way's plane. The Fermi Bubbles may be related to past activity of the supermassive black hole at our galaxy's heart. *NASA/DOE/Fermi LAT Collaboration*

Crab Nebula

The Crab Nebula, a young supernova remnant containing a pulsar, surprised Fermi astronomers with gamma-ray flares set off by the most energetic particles ever traced to a specific astronomical object. To account for the flares, scientists say electrons near the pulsar must be accelerated to energies a thousand trillion (10^{15}) times greater than visible light.
NASA/CXC/HST/ASU/J. Hester et al.